



Notes on the genus *Dendrocerus* Ratzeburg (Hymenoptera, Megaspilidae) from China, with description of two new species

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Abstract

Species of the genus *Dendrocerus* Ratzeburg, 1852 (Hymenoptera: Megaspilidae) from China were studied. Six species are recorded, of which two known species, *D. carpenteri* (Curtis, 1829) and *D. laticeps* (Hedicke, 1929) are re-described; and two species are described as new to science, *D. anisodontus* Wang, Chen and Mikó **sp. nov.** and *D. bellus* Wang, Chen and Mikó **sp. nov.**. Sequences of the 28S rDNA were generated to associate both sexes of the same species.

Keywords

Ceraphronoidea, DNA barcoding, hyperparasitoid, redescription, taxonomy

Introduction

The family Megaspilidae comprises more than 450 species in 12 genera worldwide, whereas the Chinese fauna is still insufficiently studied (Dessart 2006; Iemma et al. 2016). *Dendrocerus* Ratzeburg, 1852 is the most economically important genus of Megaspilidae (Fergusson 1980), because they are hyperparasitoids and attack the primary parasitoids of aphids. Species of *Dendrocerus* seem to be generalists (Takada 1973; Fergusson 1980; Martens and Johnson 2018). For example, the host complex of *Dendrocerus carpenteri* (Curtis, 1829) includes at least two genera of Cynipoidea and 7 genera of Chalcidoidea (Fergusson 1980). *Dendrocerus* was erected with *D. lichtensteinii* Ratzeburg, 1852 as the type species, a synonym of *Ceraphron halidayi* Curtis, 1829. This species was later designated as a type species of *Lygocerus*, a genus proposed as new by Förster (1856). Dessart (1966) synonymised *Lygocerus* with *Dendrocerus*, and *D. lichtensteinii* with *C. halidayi*. *Dendrocerus* is a cosmopolitan genus, with 118 described species worldwide. There were only 15 *Dendrocerus* species recorded from the Oriental region (Johnson and Musetti 2004; Trietsch et al. 2018) and four species are known from China: *D. angustus* Dessart, 1999, *D. carpenteri*, *D. aphidum* (Rondani, 1877), and *D. laticeps* (Hedicke, 1929).

Based on antennal characters, Dessart (1995) proposed five species-groups for *Dendrocerus*: *halidayi*, *carpenteri*, *serricornis*, *punctipes* and *penmaricus* (Bijoy and Rajmohana 2014). Species of the *halidayi* species-group generally have ramosae antennae, but the *D. mexicali* species complex have moveable branches (Burks et al. 2016). The males of the *D. halidayi* species-group are characterized by their ramosae antennae, and by the long branches on proximal 4, 5 or 6 flagellomeres. There are 22 species of this group worldwide (Pezzini et al. 2014). Two new species under *D. halidayi* species-group, viz., *D. bellus* and *D. anisodontus* are hereby described and illustrated.

Materials and methods

This work is based upon the specimens in the following collections, with abbreviations used in the text: **AHNU**, Auhui Normal University, Anhui, China; **IZCAS**, Institute of Zoology, Chinese Academy of Sciences, Beijing, China; **SYSBM**, Sun Yat-sen University, The Museum of Biology, Guangzhou, China. Specimens were obtained from sweep nets, Malaise traps, and yellow pan traps.

Considering that sexual dimorphism is common in *Dendrocerus*, we sequenced the gene marker 28S rDNA to associate the female and male of the same species. Genomic DNA was extracted from a female and male of each putative species using a nondestructive DNA extraction protocol as described in Taekul et al. (2014). The primers for 28S amplification followed Zhang et al. (2008). Polymerase chain reactions (PCRs) were performed using a 25 μ L system and conducted in a T100 Thermal Cycler (Bio-Rad). Thermocycling conditions were: an initial denaturing step at 94 °C for 1 min, followed by 35 cycles of 94 °C for 1 min, 50 °C for 30 s, 72 °C for 30 s and

Table 1. Detail information of sequenced samples and accession numbers.

Species	Sex	Location	GenBank accession number
<i>D. carpenteri</i>	male	Shandong, Yucheng	MZ340592
	female	Anhui, Chuzhou, Mingguang	MZ340590
<i>D. laticeps</i>	female	Anhui, Chuzhou, Mingguang	MZ340593
	female	Anhui, Chuzhou, Mingguang	MZ340624
<i>D. bellus</i> sp. nov.	female	Guangdong, Guangzhou	MZ344975
	male	Guangdong, Guangzhou	MZ344976
<i>D. anisodontus</i> sp. nov.	female	Yunnan, Menghai, Mt. Bulang	MZ344977
	male	Yunnan, Menghai, Mt. Bulang	MZ344978

an additional extension at 72 °C for 5 min. Amplicons were directly sequenced in both directions with forward and reverse primers by GENERAL BIOL (Anhui, China). Chromatograms were assembled with Sequencing Analysis 6 (ThermoFisher Scientific, Gloucester, UK). All the amplified sequences were deposited into GenBank (see Table 1). The genetic distances were calculated using the Kimura 2-parameter (K2P) model in MEGA X (Kumar et al. 2018).

All voucher specimens were then point-mounted and air-dried. Photographs were taken with a Leica M205A stereomicroscope and a Leica DFC-500 digital camera, with extended focusing software. To prepare male genitalia for study, apical metasomal segments were removed from specimens and placed in 35% H₂O₂ for 24 hours, 5% acetic acid for 24 hours, distilled water for one hour and then transferred to a droplet of glycerin on a concavity slide. Dissections were performed in glycerin by using #5 forceps and #2 insect pins.

Abbreviations and morphological terms (Table 2) follows Mikó and Deans (2009). Measurements are given in microns. Genitalia terminology follows Hymenoptera Anatomy Ontology (Yoder et al. 2010).

Results

In the present paper, we describe two new species of *Dendrocerus*: *D. anisodontus* Wang, Chen and Mikó sp. nov. and *D. bellus* Wang, Chen and Mikó sp. nov., bringing the species number of this genus to six for China. The morphological re-description and photographs are provided for *D. carpenteri* and *D. laticeps*. No Chinese specimens of *D. angustus* and *D. aphidum* are available for this study.

Eight 28S sequences of four species (length ranged from 633 to 641 bp) from China were attained and uploaded to GenBank (Table 1). The pairwise corrected genetic distances based on 28S rDNA sequences of four species, including the two new species, are shown in Table 3. Sequences of both sexes of three putative species (*D. anisodontus*, *D. bellus* and *D. carpenteri*) are 100% identical, confirming the correct association of female and male of the species. Whereas interspecific genetic distances among different *Dendrocerus* species range from 0.008 to 0.030. This will be helpful for molecular identification and the association of the female and male of the same species in this genus.

Table 2. Abbreviations and morphological terms used in text.

Abbreviations	Paraphrase
F1, F2, ..., F9	antennomere 1, 2, ..., 9
LOL	lateral ocellar length, shortest distance between inner margins of median and lateral ocelli
OOL	ocular ocellar length, minimum distance between a posterior ocellus to the eye margin
POL	posterior ocellar length, shortest distance between inner margins of posterior ocelli
HH	head height, lateral view
EHf	eye height, anterior view
HL	head length
HW	head width
IOS	interorbital space
CSB	cephalic size
T1, T2, ..., T4	metasomal tergite 1, 2, ..., 4
Prn	Pronotum
AscW	anterior mesoscutal width
PscW	posterior mesoscutal width
mms	median mesoscutal sulcus
gsp	gonostipes

Taxonomy

Dendrocerus Ratzeburg, 1852

Dendrocerus Ratzeburg, 1852: 180. Type species: *Dendrocerus lichensteinii* Ratzeburg, by monotypy (= *Ceraphron halidayi* Curtis).

Diagnosis. Head moderately transverse; facial pit absent in most species. Males usually with an obtuse ocellar triangle (POL longer than LOL). Male flagellomeres usually asymmetrical, serrate or trapezoidal. Some species also have branched flagellomeres (*D. mexicali* group). Metapleural sulcus shape usually straight. Sternaulus never present. Medioventral conjunctiva of gonostyle-volsella complex (parossiculi fusion) absent. Wings never absent (Trietsch et al. 2020).

Dendrocerus carpenteri (Curtis, 1829)

Figs 1, 2

Ceraphron carpenteri Curtis, 1829: 249.

Cerapilron crispus Curtis, 1829: 249. Nomen nudum.

Ceraphron elegans Curtis, 1829: 249. Nomen nudum.

Megaspilus carpenteri (Curtis) Stephens, 1829: 401.

Calliceras carpellteri (Curtis) Westwood, 1840: 77.

Ceraphroll hyalinatus Thomson, 1858: 291.

Lygocerus carpenteri (Curtis) Marshall, 1868: 158.

Coryne carpenteri (Curtis) Buckton, 1876: pl. 7.

Megaspillts niger Howard, 1890: 247.

Table 3. Genetic distance of 28S of four *Dendrocerus* species (F = female, M = male).

	1	2	3	4	5	6	7	8
1. <i>D. carpenteri</i> M								
2. <i>D. carpenteri</i> F	0.000							
3. <i>D. laticeps</i> F	0.008	0.008						
4. <i>D. laticeps</i> F	0.008	0.008	0.000					
5. <i>D. bellus</i> sp. nov. M	0.030	0.030	0.022	0.022				
6. <i>D. bellus</i> sp. nov. F	0.030	0.030	0.022	0.022	0.000			
7. <i>D. anisodontus</i> sp. nov. M	0.013	0.013	0.008	0.008	0.027	0.027		
8. <i>D. anisodontus</i> sp. nov. F	0.013	0.013	0.008	0.008	0.027	0.027	0.000	

Trichosteresis proxima Kieffer, 1907: 32.

Trichosteresis punctatipennis Kieffer, 1907: 33.

Lygocerus rlijiventrls Kieffer, 1907: 45.

Lygocerls campestris Kieffer, 1907: 48.

Lygocerus aphidivorus Kieffer, 1907: 49.

Lygocerls aphidivorus var. *inconspicuus* Kieffer, 1907: 50.

Lygocerus testaceimanus Kieffer, 1907: 51.

Lygocerus aphidum Kieffer, 1907: 52.

Lygocerus giraudi Kieffer, 1907: 52.

Lygocerus cameroni Kieffer, 1907: 56.

Lygocerus thomsoni Kieffer, 1907: 57.

Lygocerus inquilinus Kieffer, 1917: 349.

Trichosteresis carpenteri (Curtis) Morley, 1929: 55.

Lygocerus ambianus Dessart, 1965: 158.

Delldrocerus britannicus Dessart, 1966: 12.

Delldrocerus tischbeini Dessart, 1966: 12.

Delldrocerus carpenteri (Curtis) Dessart, 1970: 142.

Material examined. CHINA • 1 male, 2 females; Jiangsu, Suzhou; 20.IV.2019; H. Li leg.; (AHNU) • 4 females; Shandong, Yucheng; 17.V.2019; R. Zhang leg.; (IZCAS) • 3 females; Anhui, Chuzhou, Mingguang; 28.IV.2019; H. Li leg. (SYSBM).

Redescription. Male. Body length: 1.8 mm.

Coloration (Fig. 1): Cranium, mesosoma and metasoma black. Eyes, mouth-parts light brown; ocelli brownish yellow. Antennae black. Legs chocolate brown with brownish-yellow joints. Syntergum dark brown to black (Fig. 1G); gaster black or brown, mostly smooth. Pterostigma, costal vein, and radial vein brown (Fig. 1F). Body pubescence white; marginal fringes of wings brown.

Head (Fig. 1C): Slightly wider than mesosoma (about 1.1× wider than mesosoma). HH: EHf = 1.8–1.9. HH: HL = 1.2–1.3. HW: IOS = 1.7–1.8. HW: HH = 1.1–1.2. CSB: Mean: 550–630 µm. POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.4–1.6. POL: OOL = 1.4–1.5. Covered with short pubescence except glabrous clypeus and adjacent areas; head concolorous below and above eye midlevel; mandibles and palps brown. Facial pit present.

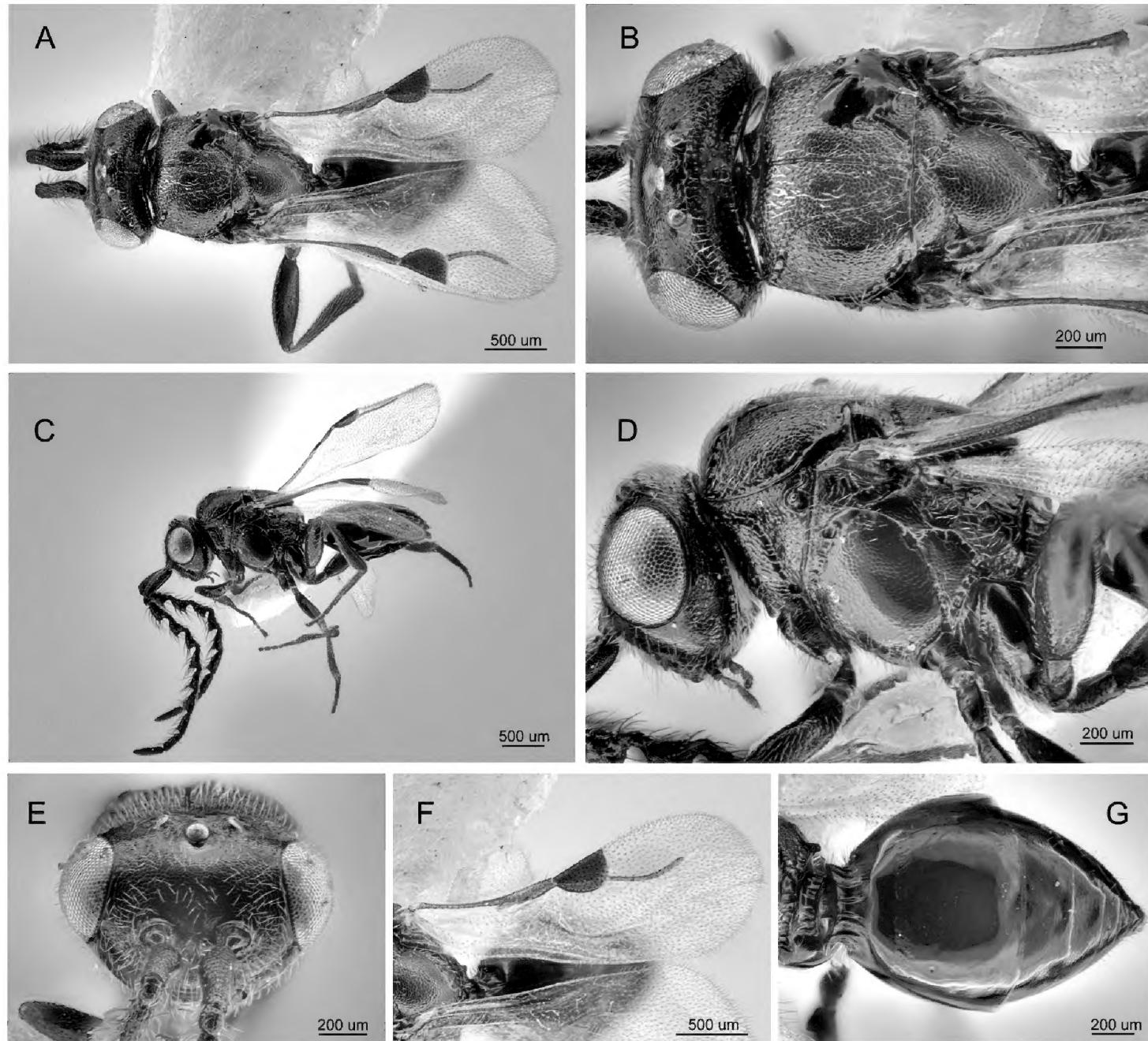


Figure 1. *Dendrocerus carpenteri* (Curtis, 1829), male **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

Intertorular carina absent. Preoccipital lunula present, more distinct and transverse in males than in females. Hyperoccipital carina present medially, not extending to eyes laterally. Preoccipital furrow present.

Antennae (Fig. 1C): Scape about 1.1× longer than combined length of pedicel and F1. Scape length vs. pedicel length: 3.5–4.9. Scape length vs. F1 length: 1.6–3.8. F1 length vs. pedicel length: 1.3–2.2. F1 length vs. F2 length: 1.1–1.4. Longest flagellomere: F1. Basal flagellar segments ventrally slightly concave; strongly serrate, gradually becoming less serrate distally. Flagellar pubescence long, at least as long as breadth of antennomeres.

Mesosoma (Fig. 1B, D): Pronotum not elongate. $\text{AscW}/\text{PscW} = 0.7–0.8$. Mesosoma slightly narrow (1.4× longer than wide) (Length/width/height = 770/550/550 μm); coriaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 380/490 μm); mesoscutum 1.3× wider than long, with more or less straight anterior margin. Transverse pronotal sulcus and posterior pronotal sulcus

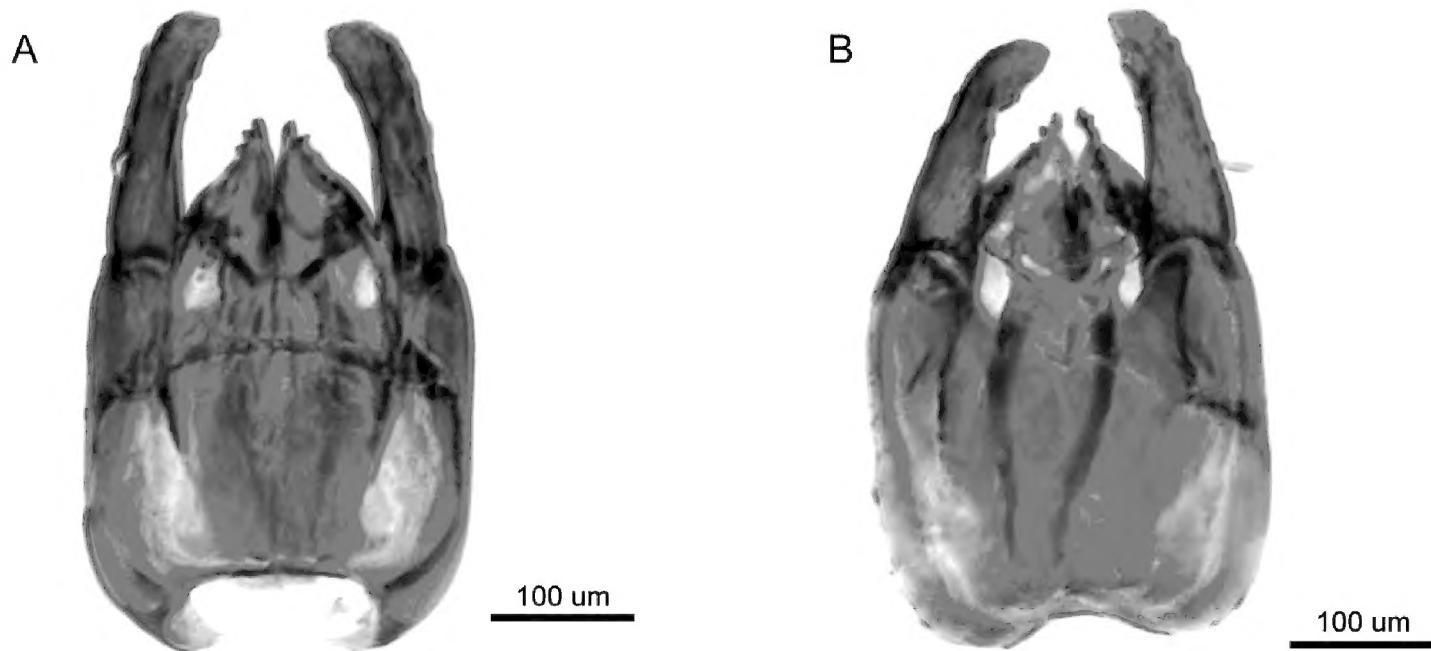


Figure 2. *Dendrocerus carpenteri* (Curtis, 1829), male, genitalia **A** dorsal view **B** ventral view.

present, distinct. Mesonotum wider than long, almost quadrate. Notauli complete, strongly angled and convergent posteriorly. Mesoscutellum broad and convex. Lateral axillar area distinctly higher than long. Mesopleural sulcus present. Propodeum medially short. Posterior propodeal carina present, more distinct laterally. Postero-dorsal metapleural area trapezoid-shaped.

Wings (Fig. 1F): Total wing length 1.3 mm. Hyaline, pterostigma (Length/width = 170/90 μ m) nearly semicircular but distal edge almost straight. Radius (190 μ m), strongly curved, often continuing distally without pigmentation.

Metasoma (Fig. 1G): Metasoma concolorous with mesosoma. Metasoma 1.5 \times longer than wide (Length/width/height = 800/540/406 μ m). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with dense punctures in middle and posterior of syntergum. Several strong transverse gastral carinae present in basal portion of metasoma; gastrocoeli not evident; posterior tergites with setae.

Male Genitalia (Fig. 2): Genitalia with short cupula. Harpe median margin smooth and without tooth. Distal margin of harpe in lateral view blunt. Gonostipes longer than wide, fused dorsally; apical margin (part of gonostipes) with three teeth outward (Fig. 2A). Median notch of distodorsal margin of gonostipes square.

Female (Fig. 3): Body length: 1.8–2.1 mm. As for male except scape longer (scape about 1.3 \times longer than combined length of pedicel and F1). Pedicel and F1 approximately equal in length. Rest of flagellar segments short (L/B about 1.1–1.6), except F9 which is usually twice as long as broad. Flagellomeres flattened ventrally. Antenna black but distal end of pedicel sometimes lighter; weakly papillate, with short dense pubescence.

Distribution. China (Shandong, Shanghai, Anhui, Zhejiang, Jiangsu, Hubei, Jiangxi, Fujian, Taiwan, Guizhou, Yunnan); Australasian, Oceanian, Neotropical, Oriental, and Palearctic.

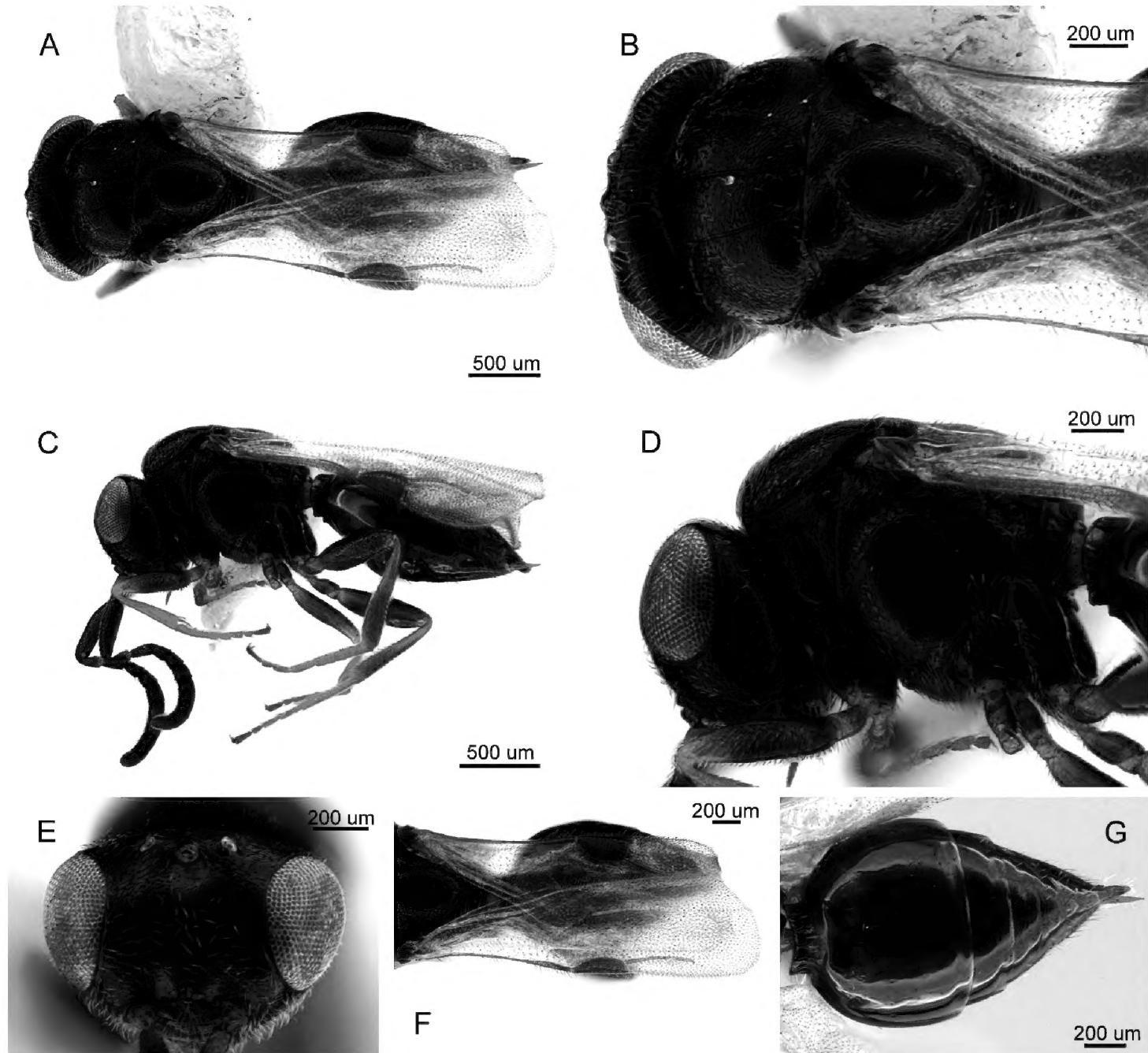


Figure 3. *Dendrocerus carpenteri* (Curtis, 1829), female **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

Dendrocerus laticeps (Hedicke, 1929)

Fig. 4

Atritomellus laticeps Hedicke, 1929: 60.

Lygocerus laticeps (Hedicke) Hellen, 1966: 15.

Dendrocerus laticeps (Hedicke) Dessart, 1972: 186.

Material examined. CHINA • 2 females; Anhui, Chuzhou, Mingguang; 28.IV.2019; H. Li leg. (AHNU).

Description. Female: Body length: 1.8–1.9 mm.

Coloration (Fig. 4): Cranium and mesosoma black, metasoma alutaceous to black. Mouthparts brown or yellow; eyes light brown; ocelli brown. Flagellum black or brown. Basal scape and AIII yellow, with other antennae segments black. Legs usually

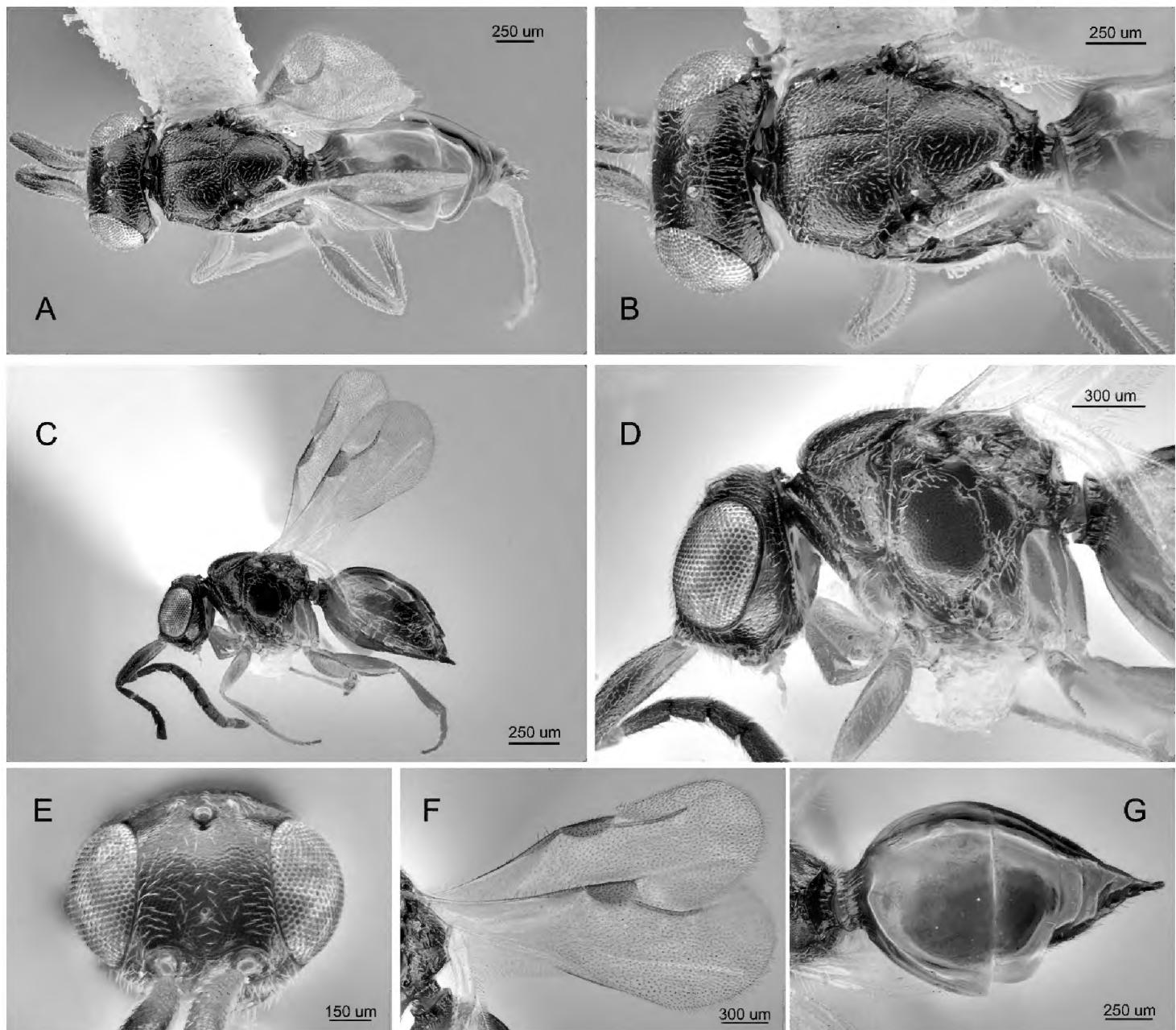


Figure 4. *Dendrocerus laticeps* (Hedicke, 1929) female **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

yellow, sometimes darkened proximally, especially on lateral side of hindlegs. Syntergum yellow to dark brown (Fig. 4G). Pterostigma, costal vein, and radial vein light brown (Fig. 4F). Body pubescence white; marginal fringes of wings brown.

Head (Fig. 4C): Slightly wider than mesosoma (about 1.2× wider than mesosoma). HH: EHf = 1.8–1.9. HH: HL = 0.8–1.0. HW: IOS = 1.5–1.7. HW: HH = 0.9–1.0. CSB: Mean: 520–600 µm. POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.6–1.8. POL: OOL = 1.1–1.2. Broad and pubescence short; head concolorous below and above eye midlevel; mandibles and palps yellow. Facial pit present. Intertorular carina distinct. Eyes usually large. Ocellus triangle broad and short lateral ocelli well separated from eyes. Preoccipital lunula present. Occipital carina strongly developed. Preoccipital furrow present.

Antennae (Fig. 4C): Scape about 1.6× longer than combined lengths of pedicel and F1. Scape length vs. pedicel length: 4.1–4.8. Scape length vs. F1 length: 2.8–3.3. F1 length vs. pedicel length: 1.5–1.8. F1 length vs. F2 length: 1.2–1.5. Longest flagel-

lomere: F1. F1 longer than F2. Pedicel long. F1 long and thin, about 3 times as long as broad, distal flagellar segments broader, less elongate, with flat area ventrally. F2 sometimes slightly asymmetrical. Scape never completely dark, normally (when viewed dorsally) with distinct light-coloured basal band, but sometimes indistinct. Pubescence rather short.

Mesosoma (Fig. 4): Pronotum not elongate. $\text{AscW}/\text{PscW} = 0.8–0.9$. Mesosoma slightly narrow ($1.3 \times$ longer than wide) (Length/width/height = 560/420/470 μm); coriaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 281/300 μm); mesoscutum $1.1 \times$ wider than long, with more or less straight anterior margin. Notauli very distinct but present only anteriorly, disappearing immediately after bend. Median furrow distinct. Lateral axillar area longer than high. Mesopleural sulcus present. Median projection of lateral prodeal carina present. Anterior metanotal margin with conspicuous furrow passing under apex of scutellum. Propodeum with projections posteriorly. Sparsely crenulate furrow. Median propodeal projection weakly developed. Lateral thoracic segments bordered by conspicuous foveolate or crenulate furrows. Posterodorsal metapleural area trapezoid-shaped.

Wings (Fig. 4F): Total wing length 1.1 mm. Clear, pubescence long, fringe long and obvious. Prerostigma noticeably semi-oval, long and thin (Length/width = 130/80 μm). Radius (160 μm), curved a little in the middle and slightly longer ($1.2 \times$) than pterostigma; forewing densely pubescent and marginal fringes numerous; hindwing without venation.

Metasoma (Fig. 4G): Metasoma lighter than mesosoma. Mesosoma $1.5 \times$ longer than wide (Length/width/height = 560/420/470 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with numerous pit-like punctuations in middle and posterior of T3. Several strong transverse gastral carinae present in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

Distribution. China (Shandong, Anhui, Jiangsu, Hubei, Fujian, Guangdong, Guangxi); Australasian; Oceanian; Nearctic; Palearctic; Oriental.

Dendrocerus anisodontus Wang, Chen & Mikó, sp. nov.

<http://zoobank.org/8C5BDFA5-7F51-4218-B83F-6C6A81022948>

Figs 5–7

Diagnosis. This new species belongs to the *D. halidayi* species-group and can be separated from other species by the following characteristics: metasoma concolorous with mesosoma and head; intertorular carina present, blunt harpe with numerous setae; distal parossicula projection cone.

Material examined. **Holotype** CHINA • male; Yunnan, Menghai, Mt. Bulang; 20.VII–21.VIII.2019; L. Ma leg. (SYSBM). **Paratypes** (29 males, 89 females)

CHINA • 1 female; Hebei, Baoding, Hebei Agri. Univ. West Campus; MT; 12–19. VII.2017; F. Fan (SYSBM) • 2 females; same collection data as for preceding; 20–27.

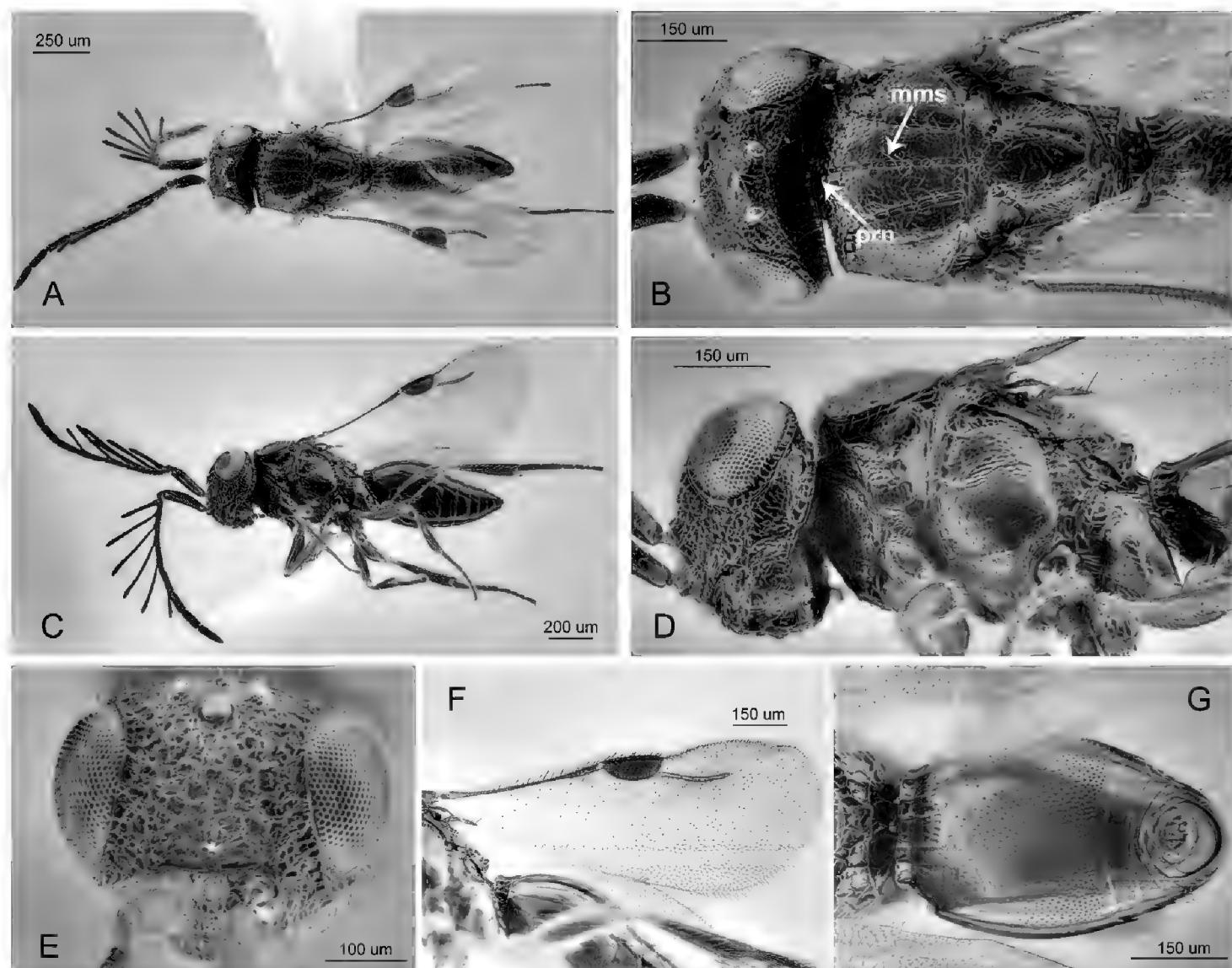


Figure 5. *Dendrocerus anisodontus* Wang, Chen and Mikó sp. nov., male, holotype **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view. Abbreviations: pronotum (prn), median mesoscutal sulcus (mms).

VI.2017; (IZCAS) • 4 females; same collection data as for preceding; 27.VI–4.VII.2017; (AHNU) • 1 female; Shandong, Shanghe; MT; 26.I.2018; J. Yan leg.; (SYSBM) • 4 females, same collection information as for preceding; 4–10.VIII.2018; (IZCAS) • 1 female; Zhejiang, Mt. Fengyang; 28.VII.2007; L. Zhu leg.; (AHNU); • 1 female; Zhejiang, Mt. Tianmu, 1200 m; 25–29.VII.2011; H. Chen leg.; (SYSBM) • 1 male; Zhejiang, Mt. Gutian; 5.VII.2015 • 1 female; Hunan, Mt. Mangshan; YPT; 13.VIII.2010; H. Chen leg.; (IZCAS) • 1 male; Fujian, Minqing County, Huangchulin Nature Reserve; 13–17.VII.2005; J. Liu leg.; (AHNU) • 2 males; Guangdong, Nanling National Natural Reserve; 8–17.VIII.2010 • H. Chen and H. Chen leg.; (AHNU) • 1 female; Guangdong, Nanling Protection Station; YPT; 16–17.V.2011; Z. Xu leg.; (SYSBM) • 1 male; same collection information as for preceding; 1200 m; 17.V.2011; N. Wei leg.; (IZCAS) • 1 female; Guangdong, Mt. Nankun; 19.VIII.2016; Z. Xu leg.; (AHNU) • 1 male; Guangdong, Guangzhou, SYSU Bamboo Garden; 20.I–18.II.2019; H. Chen leg.; (SYSBM) • 1 male; same collection information as for preceding; 23.VII.2018–20.I.2019; H. Chen leg.; (IZCAS) • 1 female; same collection information as for preceding; 10.I–18.IV.2020; H. Chen leg.; (IZCAS) • 1 male; Guangdong, Huizhou City,

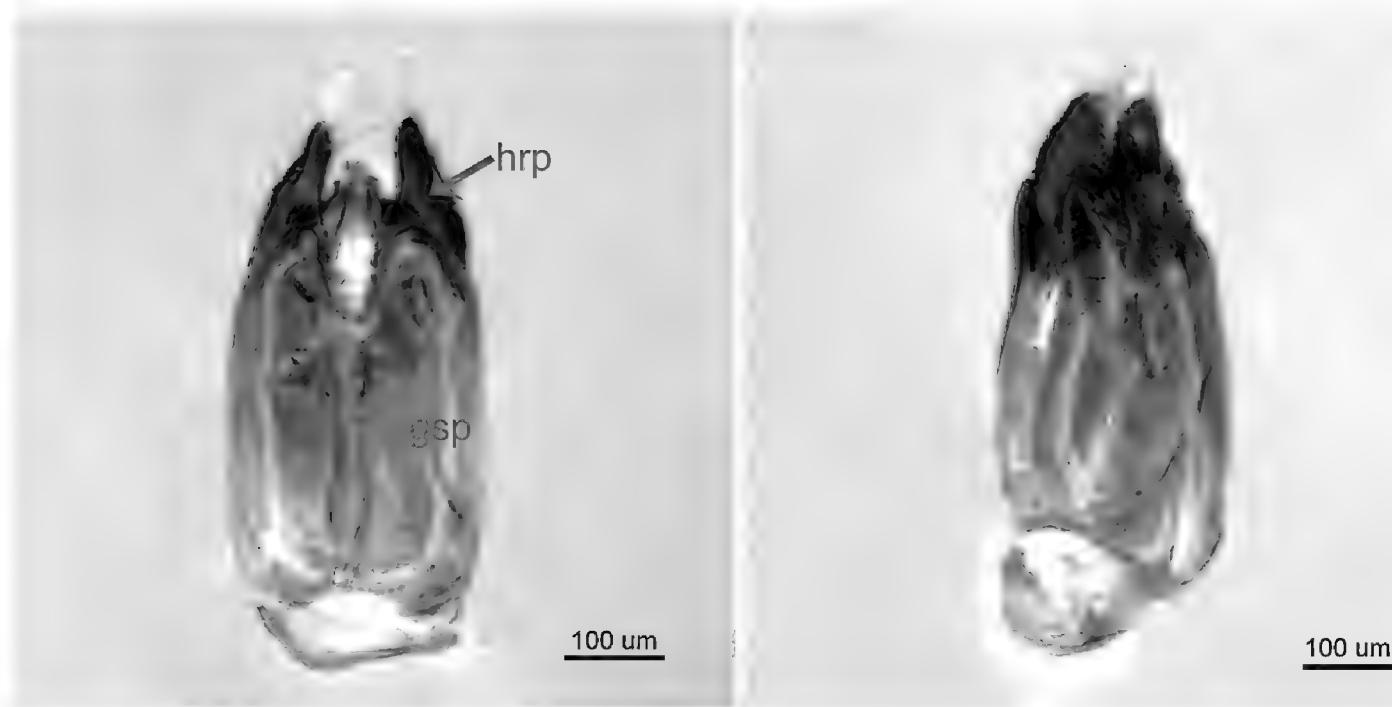


Figure 6. *Dendrocerus anisodontus* Wang, Chen and Mikó sp. nov., male, holotype, genitalia **A** dorsal view **B** lateral view. Abbreviations: harpe (hrp), gonostipes (gsp).

Mt. Gutian; 30.V–30.VI.2019; L. Chen et al. leg.; (AHNU) • 1 female; Guangdong, Qingyuan, Lian Zhou; YPT; 10–13.VI.2019; H. Chen leg.; SCAU 3049491 (AHNU) • 1 female; Guangdong, Dongguan City, Mt. Daling; 20–30.IX.2019; L. Chen et al. leg.; (IZCAS) • 1 male, 1 female; Guangdong, Guangzhou City, South China Botanical Garden; 7.II–16.III.2020; H. Huang et al. leg.; (SYSBM) • 1 male; Hainan, Baisha County, Jiujiang; 11.VII.2010; H. Chen leg.; (IZCAS) • 1 female; Hainan, Mt. Diaboluo; YPT; 12–13.VII.2010; H. Chen et al. leg.; (SYSBM) • 1 female; Hainan, Jianfengling; 14–16.VII.2010; H. Chen leg.; (AHNU) • 7 females; Hainan, Danzhou City, Institute of Environmental and Plant Protection; 20–30.VI.2019; S. Dong leg.; SCAU 3049465 (SYSBM) • 2 females, same collection information as for preceding; 4–20.VI.2019; S. Dong leg.; SCAU 3049467 (IZCAS) • 1 female; Same collection information as for preceding; 30.VI–10.VII.2019; S. Dong leg.; SCAU 3049474 (AHNU) • 2 females; Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049488 (SYSBM) • 1 female; Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049474 (IZCAS) • 2 females, Same collection information as for preceding; 30.VII–10.VIII.2019; S. Dong leg.; SCAU 3049489 (AHNU) • 2 females; Same collection information as for preceding; 10–20.VIII.2019; S. Dong leg.; SCAU 3049481 (SYSBM) • 5 females; Same collection information as for preceding; 20–30.VIII.2019; S. Dong leg.; SCAU 3049484 (IZCAS) • 6 females; Same collection information as for preceding; 30.VIII–10.IX.2019; S. Dong leg.; SCAU 3049480 (AHNU) • 4 females; Same collection information as for preceding; 30.XI–30.XII.2019; S. Dong leg.; SCAU 3049487 (IZCAS) • 1 female; Same collection information as for preceding; 20–30.XI.2019; S. Dong leg.; SCAU 3049473 (AHNU) • 1 female; Same collection information as for preceding; 30.XI–30.XII.2019; S. Dong leg.; SCAU 3049469 (SYSBM) • 3 males, 5 females; Same collection information as for preceding; 20–30.IX.2019; S. Dong leg.; SCAU

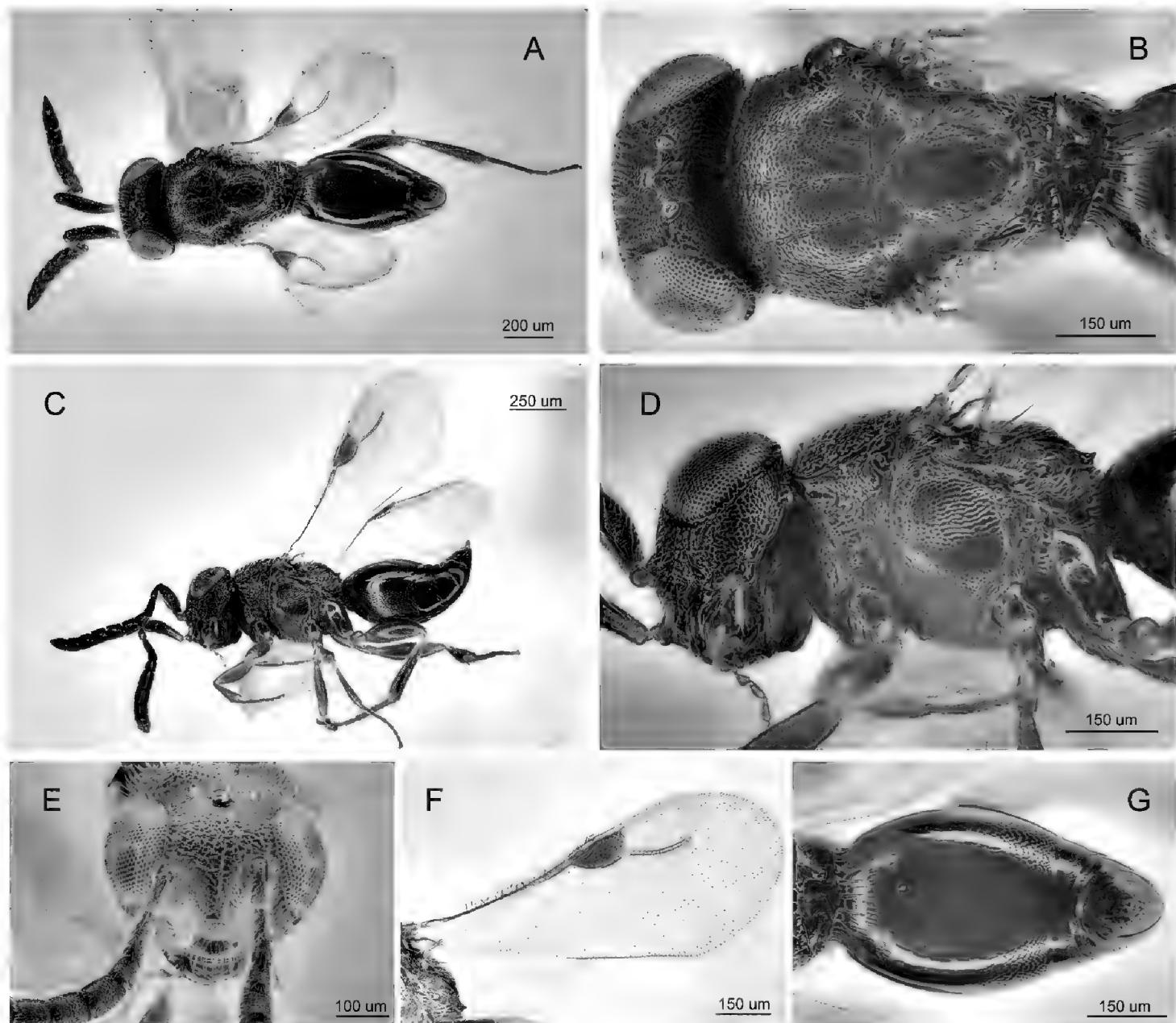


Figure 7. *Dendrocerus anisodontus* Wang, Chen and Mikó sp. nov., female, paratype **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

3049483 (IZCAS) • 2 males, 2 females; Same collection information as for preceding; 30.X-30.XI.2019; S. Dong leg.; SCAU 3049485 (SYSBM) • 1 male; Same collection information as for preceding; 10–20.X.2019, S. Dong leg.; SCAU 3049472 (IZCAS) • 2 females; Same collection information as for preceding; 20–30.VIII.2019; S. Dong leg.; SCAU 3049476 (AHNU) • 1 female; Same collection information as for preceding; 10–20.IX.2019; S. Dong leg.; SCAU 3049477 (SYSBM) • 3 females; Same collection information as for preceding; 30.VIII–10.IX.2019; S. Dong leg.; SCAU 3049471 (IZCAS) • 4 females; Same collection information as for preceding; 30.X–30.XI.2019; S. Dong leg.; SCAU 3049470 (AHNU) • 4 males, 3 females; Same collection information as for preceding; 30.IX–10.X.2019; S. Dong leg.; SCAU 3049486 (SYSBM) • 1 female; Same collection information as for preceding; 30.X–30.XI.2019; S. Dong leg.; SCAU 3049470 (IZCAS) • 1 female; Same collection information as for preceding; 30.IX–10.X.2019; S. Dong leg.; SCAU 3049486 (AHNU) • 1 male; Guangxi, Xingan County, Huaijiang Village, 380 m; 26–27.VI.2011; N. Wei leg.; (SYSBM) • 2 females;

Guangxi, Nanning, Mt. Longshan, 370 m; 1–2.VII.2011; Z. Xu leg.; (IZCAS) • 1 female; Sichuan, Pingwu, Baimazhai; 25.VII.2005; H. Zhang leg.; (AHNU) • 1 male; Sichuan, Yaan City, Zhangjiashan Park; 14.VII.2006; Z. Gao leg.; (SYSBM) • 1 male; Shaanxi, Liping Forest Experiment Station; 23.VII.2004; Q. Wu leg.; (IZCAS) • 1 male; Guizhou; Leigong Mountain Forest Farm; 1.VI.2005; H. Zhang leg.; (IZCAS) • 2 females; Guizhou, Kuankuoshui Protection Center; 3.I.2010; J. Zeng leg.; (SYSBM) • 1 male, 1 female; Yunnan, Gejiu, Lüchun County; 25.VII.2003; (AHNU) • 1 female; Yunnan, Xianggelila Gaoshan Botanical Garden; 27.III.2017; J. Zeng leg.; (IZCAS) • 1 female, 1 male; Yunnan, Xishuangbanna Rainforest, 599 m; 24.IV–31.V.2017; L. Ma leg.; (SYSBM) • 1 male; Yunnan, Xianggelila, Gaoshan Botanical Garden; 27.III.2017; (AHNU) • 1 male, 2 females; Yunnan, Menghai, Mt. Bulang, 1683 m; MT; 17.V–21.VI.2018; L. Ma leg.; (SYSBM) • 1 female; Same collection information as for preceding; 21.VIII–20.IX.2019; L. Ma (IZCAS).

Description. Male: Body length: 1.8–2.1 mm.

Coloration (Fig. 5): Cranium, mesosoma and metasoma black; eyes brown to black; ocelli brown; scape and basal pedicel yellow; flagellum dark brown to black; fore and mid coxa along with femur and tibia brown with brownish joints; syntergum brown (Fig. 5A); pterostigma and costal vein brown; radial vein brown (Fig. 5F); body pubescence white; marginal fringes of wings brown.

Head (Fig. 5C): Slightly wider than mesosoma (about 1.1× wider than mesosoma). HH: EHf = 1.9–2.1. HH: HL = 1.2–1.6. HW: IOS = 1.8–1.9. HW: HH = 1.2–1.3. CSB: Mean: 350–470 μm . POL longer than OOL and ocellar triangle with broad base. OOL: LOL = 1.8–1.9. OOL: POL = 1.0–1.1. Head shape transverse in dorsal view, concolorous below and above eye midlevel. Preoccipital lunula absent (Fig. 5B). Facial pit absent. Intertorular carina distinct; ocular suture prominent and foveolate; frons with sparse hairs; densely pubescent at gena (Fig. 5B); Preoccipital furrow present.

Antennae (Fig. 5C): Ramose with six branches; scape nearly four times longer than wide; pedicel small and almost globular. Scape length vs. pedicel length: 4.7–4.8. Scape length vs. F1 length: 3.6–3.7. F1 length vs. pedicel length: 1.3–1.5. F1 length vs. F2 length: 0.9 μm . Longest flagellomere: F9. Length of setae on flagellomere vs. flagellomere width: setae as long as or shorter than width of flagellomeres. Basal flagellar segments clearly asymmetrical, with long projections.

Mesosoma (Fig. 5B, D): Pronotum not elongate. AscW/PscW = 0.7–0.8. Mesosoma slightly narrow (1.1× longer than wide) (Length/width/height = 640/600/560 μm); coriaceous in sculpture, densely pubescent. Mesoscutum: (Length/width = 350/570 μm); mesoscutum 1.6× wider than long, with more or less straight anterior margin; anterior corners of mesoscutum sharply angled; mesoscutal humeral sulcus evident; coarsely foveolate notauli angled sharply. Median mesoscutal sulcus present and complete, terminating adjacent to the transscutal articulation (Fig. 5B); scutellum 0.9× longer than wide, narrowed at apex with densely setose lateral margin; lateral scutellar carina evident; scutellum convex and highly sculptured with numerous hairs; metanotum and propodeum carinated. Posterodorsal metapleural area trapezoid-shaped. Mesopleural sulcus present.

Wings (Fig. 5F): Total wing length 1.5 mm. Hyaline. Pterostigma (Length/width = 220/110 μm) elliptical, 2.0 \times longer than wide; distal edge of pterostigma truncated; Radius (270 μm), curved a little in the middle and slightly longer (1.2 \times) than pterostigma; forewing densely pubescent and marginal fringes numerous; hindwing without venation. Dark area on fore wing absent.

Metasoma (Fig. 5G): Metasoma concolorous with mesosoma. Mesosoma 1.6 \times longer than wide (Length/width/height = 830/510/430 μm). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth, but with numerous pit like punctuations in middle and posterior of T3. Eight strong transverse gastral carinae present in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

Male genitalia (Fig. 6): Genitalia with short cupula. Harpe longer than gonostipes in lateral view; simple and not bilobed. Distal margin of harpe in lateral view blunt. Lateral setae of harpe present, but sparse (Fig. 6B). Gonostipes longer than wide, fused dorsally; apical margin (part of gonostipes) cleft medially (Fig. 6A). Median notch of distodorsal margin of gonostipes oval. Distal parossiculal projection rounded.

Females (Fig. 7): Body length: 1.9–2.1 mm. Scape about 2.6 \times longer than combined length of pedicel and F1. Scape length vs. pedicel length: 4.1–4.6. Scape length vs. F1 length: 2.8–3.3. F1 length vs. pedicel length: 1.5–1.7. F1 length vs. F2 length: 0.8–0.9. Longest flagellomere: F3. Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

Distribution. China (Hebei, Shandong, Zhejiang, Hunan, Fujian, Guangdong, Hainan, Guangxi, Sichuan, Shaanxi, Guizhou, Yunnan).

Etymology. The species name is a Greek masculine adjective meaning “unequal tooth”, signifying the irregular branches of the antennae of males.

Remarks. Like most *Dendrocerus* males, the lateral extension of the basal flagellar segments is the most notable character of *D. anisodontus* sp. nov. This is likely a device to increase the olfactory efficiency of the male, probably in its response to sex pheromones released by the female (Fergusson, 1980).

Dendrocerus bellus Wang, Chen & Mikó, sp. nov.

<http://zoobank.org/F0D399A4-6F74-490E-AE4B-675A5FA59F15>

Figs 8–10

Diagnosis. This new species belongs to the *D. halidayi* species group, and is close to *D. caelebs* but can be distinguished by its smaller body size (only 1.1–1.2 mm), unobvious notaui, body coloration, median notch of distodorsal margin of gonostipes triangle and spatulated-shaped harpe.

Material Examined. **Holotype** CHINA • male; Guangdong, Guangzhou, SYSU Bamboo Garden; 10.I–18.IV.2020; H. Chen leg.; (SYSBM) **Paratypes** (15 males, 17 females) CHINA • 7 males, 1 female; Guangdong, Guangzhou, University Town 2nd Forest; 20.I–17.II.2017; H. Chen leg.; (AHNU) • 1 male, 1 female; Guangdong,

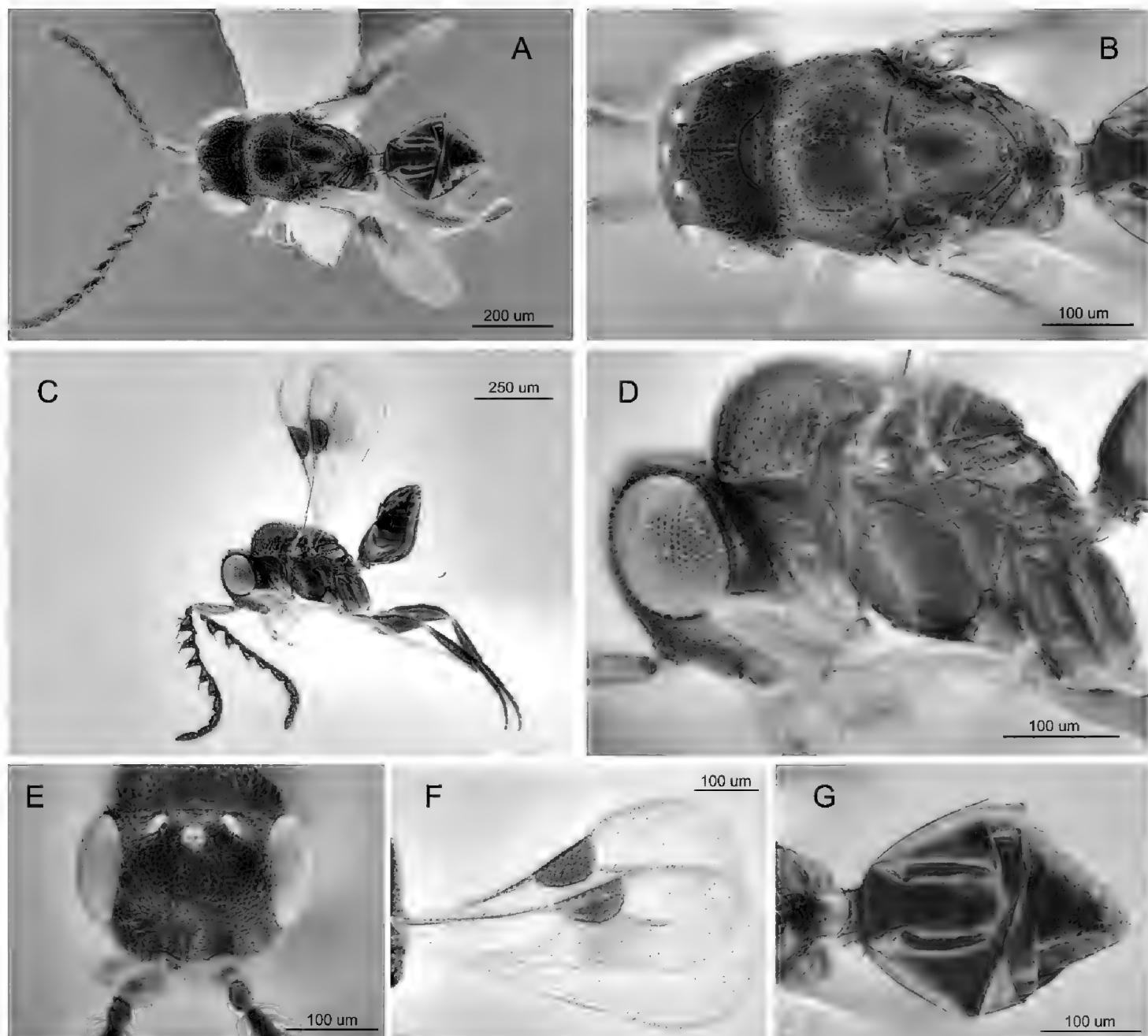


Figure 8. *Dendrocerus bellus* Wang, Chen and Mikó sp. nov., male, holotype **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

Guangzhou, University Town, 22.VII.2018–20.I.2019, H. Chen leg.; (AHNU) • 1 female; Guangdong, Dongguan, Mt. Daling, 10–20.IX.2019; L. Chen et al. leg.; (SYSBM) • 2 females; Guangdong, Guangzhou, South China Botanical Garden, 7.II–16.III.2020, H. Huang et al. leg.; (IZCAS) • 1 male; Guangdong, Huizhou, Mt. Gutian; 30.XI–30.XII.2019, L. Chen et al. leg.; (IZCAS) • 1 female; Same collection information as preceding; 20–30. IX.2019; L. Chen et al. leg.; (SYSBM) • 2 females; Guangdong, Dongguan, Mt. Daling; 30.X–30.XI.2019; L. Chen et al. leg.; (SYSBM) • 1 female; Guangdong, Mt. Dinghu; 30.XI–30.XII.2019; L. Chen et al. leg.; (IZCAS) • 4 males, 8 females; Guangdong, Guangzhou, SYSU bamboo garden; 10.I–17. IV.2020; H. Chen leg.; (IZCAS) • 1 male; Sichuan, Yaan City, Zhangjiashan Park; 14.VII.2006; Z. Gao; (AHNU) • 1 male; Yunnan, Menghai, Mt. Bulang, 1595 m; 28.V–28.VI.2019; SCAU 3049495 (AHNU).

Description. Male: Body length: 1.1–1.2 mm.

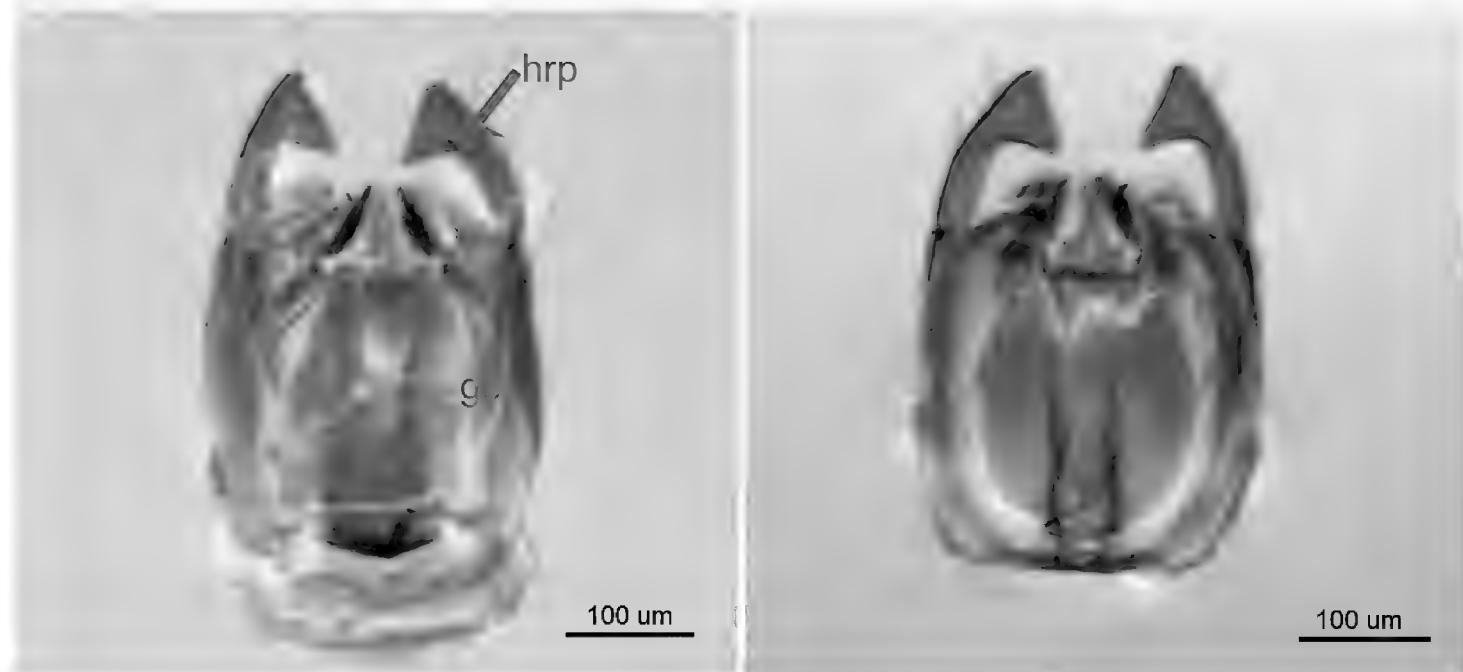


Figure 9. *Dendrocerus bellus* Wang, Chen and Mikó sp. nov., male, holotype, genitalia **A** dorsal view **B** ventral view.

Coloration (Fig. 8): Cranium, mesosoma and metasoma dark brown; eyes brown; ocelli yellow. Scape yellow, pedicel and flagellum dark brown. Fore and mid coxa along with femur and tibia yellow; syntergum dark brown (Figs 8A, G); pterostigma dark brown; costal vein and radial vein brown (Fig. 8F); body pubescence white; marginal fringes of wings brown.

Head (Fig. 8C): Head width, dorsal view: slightly wider than mesosoma (about 1.2× wider than mesosoma). HH: EHf = 1.7–1.9. HH: HL = 1.1–1.2. HW: IOS = 1.7. HW: HH = 1.1–1.2. CSB: Mean: 330–360 µm. POL shorter than OOL and ocellar triangle with broad base. OOL: LOL = 1.6–1.7. OOL: POL = 1.0–1.1. Head shape transverse in dorsal view; concolorous below and above eye midlevel. Preoccipital lunula absent (Fig. 8B). Facial pit absent. Intertorular carina curved; ocular suture prominent and foveolate; frons with sparse hairs; densely pubescent at gena (Fig. 8B). Facial pit present. Preoccipital furrow present.

Antennae (Fig. 8C): Scape nearly five times longer than wide; pedicel small and almost globular. Scape length vs. pedicel length: 6.0–7.0. Scape length vs. F1 length: 2.7–3.2. F1 length vs. pedicel length: 2.3–2.7. F1 length vs. F2 length: 0.9–1.0. Longest flagellomere: F9. Length of setae on flagellomere vs. flagellomere width: setae as long as or shorter than width of flagellomeres. Basal flagellar segments clearly asymmetrical, strongly serrate.

Mesosoma (Fig. 8B, D): Pronotum (Prn) not elongate. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW = 0.7–0.8. Mesosoma slightly narrow (1.4× longer than wide) (Length/width/height = 407/350/440 µm); coriaceous in sculpture, densely pubescent. mesoscutum: (Length/width = 127/206 µm); mesoscutum 1.6X wider than long, with more or less straight anterior margin; anterior corners of mesoscutum sharply angled; mesoscutal humeral sulcus evident; notauli thin and unobvious. Median mesoscutal

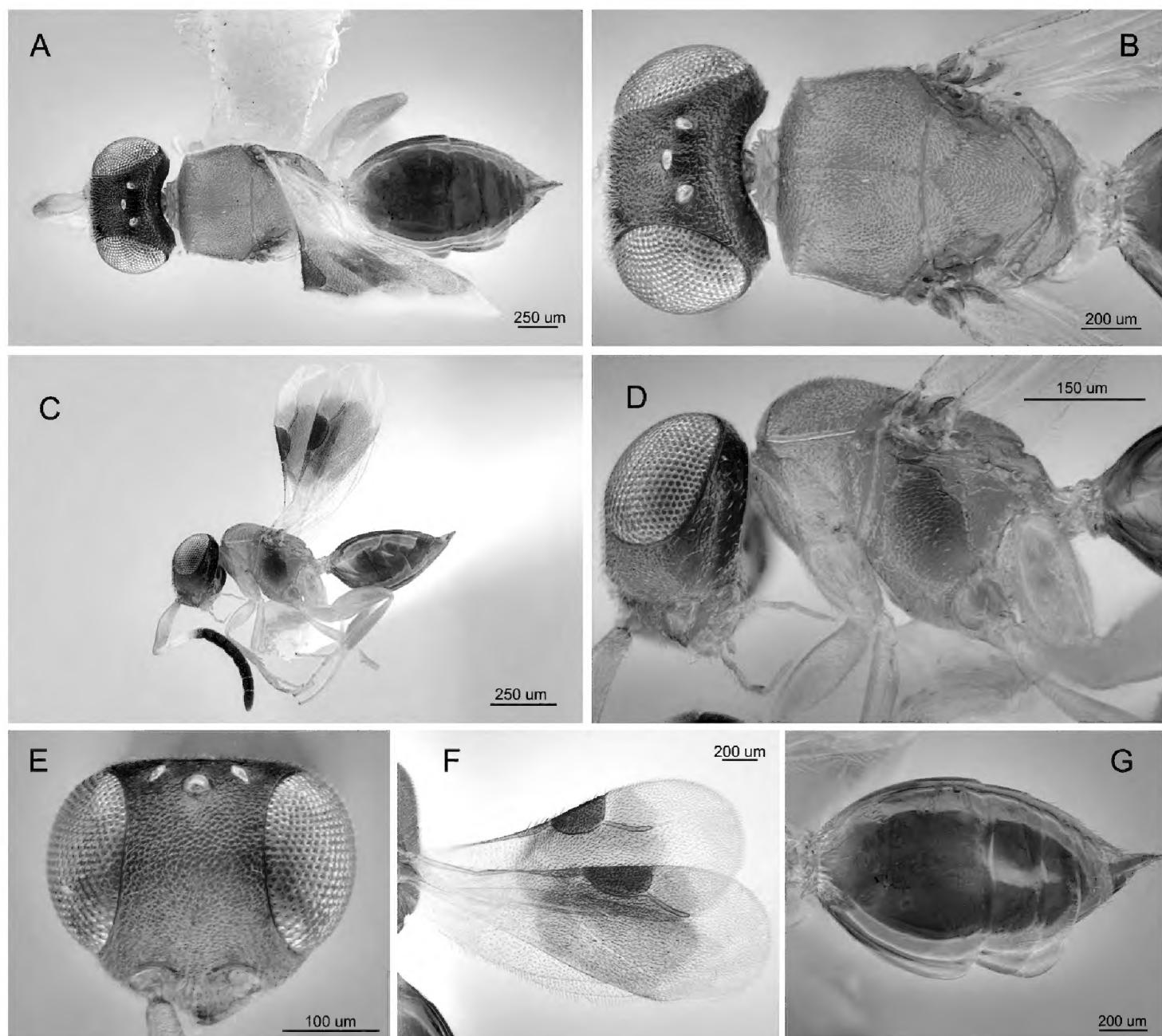


Figure 10. *Dendrocerus bellus* Wang, Chen and Mikó sp. nov., female, paratype **A** dorsal habitus **B** head and mesosoma, dorsal view **C** lateral habitus **D** head and mesosoma, lateral view **E** head, anterior view **F** wings **G** metasoma, dorsal view.

sulcus present and complete, terminating adjacent to the transscutal articulation (Fig. 8B); scutellum 0.9× longer than wide, narrowed at apex with densely setose lateral margin; lateral scutellar carina evident; scutellum convex and highly sculptured with numerous hairs; metanotum and propodeum carinated. Posterodorsal metapleural area trapezoid. Mesopleural sulcus present.

Wing (Fig. 8F): Total wing length 0.9 mm. Hyaline. Pterostigma (Length/width = 180/90 μ m) elliptical, 2.0× longer than wide; distal edge of pterostigma truncated; Radius (130 μ m), curved a little in the middle and slightly shorter (0.7×) than pterostigma; forewing tinted with light brown, densely pubescent and marginal fringes numerous; hind wing without venation. Dark area on fore wing present.

Metasoma (Fig. 8G): Metasoma lighter than mesosoma. Mesosoma 1.6× longer than wide (Length/width/height = 500/320/220 μ m). Syntergum with crenulate collar, clearly with neck. Rest of metasoma smooth. Strong transverse gastral carinae pre-

sent in basal portion of metasoma; gastrocoeli not evident; five terminal segments visible dorsally with numerous hairs.

Male genitalia (Fig. 9): Genitalia with short cupula. Harpe longer than gonostipes in lateral view, with numerous terminal long and slender setae; harpe shape spatulate and oriented medially. Lateral setae of harpe present, but sparse. Gonostipes longer than wide, fused dorsally; apical margin curved medially, spatulated-shaped. Volsella black, with sharped apically. Median notch of distodorsal margin of gonostipes triangle. Distal parossiculal projection pointed.

Females (Fig. 10): Body length: 1.35–1.44 mm. Head yellow below and brown above eye midlevel, mandibles and palps yellow. Mesosoma and metasoma yellowish, tinged with brown; eyes white; ocelli white to yellowish. Scape, pedicel and basal flagellar segments yellowish. Legs yellowish; syntergum light brown (Figs 10A, G). Metasoma darker than mesosoma. Flagellar segments symmetrical and cylindrical. Other characteristics similar to male.

Distribution. China (Guangdong, Hainan, Sichuan, Yunnan).

Etymology. The species name is a Latin masculine adjective meaning “beautiful and exquisite”, signifying the beautiful coloration, especially in female.

Acknowledgements

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